

STUDIES ON THE AGAR CONTENT IN *GRACILARIA* *ARCUATA* VAR. *ARCUATA* AND *G. CORTICATA* VAR. *CYLINDRICA*

N. Kaliaperumal, S. Kalimuthu and J.R. Ramalingam
Regional Centre of Central Marine Fisheries Research
Institute, Marine Fisheries - 623520, Tamil Nadu

Abstract

Studies on the yield and physical properties of agar was made for one year from March 1982 to February 1983 in *Gracilaria arcuata* var. *arcuata* and *G. Corticata* var. *cylindrica* growing in the intertidal belt at Kilakarai. In *G. arcuata* var. *arcuata*, the agar content varied from 38.8 to 52.2% and gel strength from 11 to 67 gm/cm². In *G. corticata* var. *cylindrica* the yield of agar ranged from 33.1 to 48.6% and gel strength from 12 to 67 gm/cm². The yield of agar in *G. corticata* var. *cylindrica* was slightly more from material cooked for 1-3 hrs at 30 lbs than at 10 and 20 lbs pressure. There was no marked variation in the yield and qualities of agar extracted in P^H ranging from 5 to 10 in these two species.

Introduction

The polysaccharides agar and carrageenan are obtained from red seaweeds. In India agar is manufactured from *Gelidiella acerosa*, *Gracilaria edulis* and *G. crassa*. Because of continuous and indiscriminate harvesting, the natural stock of these seaweeds is depleting every year. Hence an attempt was made to study the growth, reproduction and agar content of *Gracilaria arcuata* Zan. var. *arcuata* Umamaheswara Rao and *G. corticata* J. Ag. var. *cylindrica* Umamaheswara Rao growing in the Gulf of Mannar at Kilakarai, which could form an alternative source of agar. The agar content and the physical properties of the agar from these two algae are presented in this paper.

Materials and Methods

Plants of *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica* were collected at fortnightly intervals for a period of one year from March 1982 to February 1983 from the rocks situated in the intertidal region at Kilakarai (70°47'E and 9° 12'N) during the spring tide periods. *G. corticata* var. *cylindrica* was available throughout the year while *G. arcuata* var. *arcuata* grow only for 8 months during March to May and October to February. Fortnightly samples were mixed together as there was no much growth variation within a month and the monthly samples were analysed to study the seasonal variations in the yield and physical properties of agar. Materials of these two species collected in different months were mixed separately to study the effect of pressure, time of extraction and p^H on the yield and properties of agar.

Agar was extracted from 10 gm bleached seaweed by cooking with distilled water (1:30 ratio) in an autoclave. The extract was filtered, cooled at room temperature and frozen for 24 hrs in deep freezer. The frozen gel was thawed and dried in the sun for 1 or 2 days and then in an oven at 60°C to a constant weight. The gel strength of 1.5% agar solution was determined using a gelometer (Funaki and Kojima, 1951). The gelling and melting temperatures were determined using a thermometer following the movement of glass beads in the setting and melting gels. To study the effect of pressure and time of extraction on the yield and properties of agar, the materials were cooked for 1, 2 and 3 hrs

Table 1. Effect of pressure and time of extraction on the yield, gel strength, gelling and melting temperatures of agar extracted from *G. corticata* var. *cylindrica*

| Pressure (lb) | Time (hours) | Yield (%) | Gel strength of 1.5% conc. (gm.cm ²) | Gelling temp. (°C) | Melting temp. (°C) |
|---------------|--------------|-----------|--|--------------------|--------------------|
| 10 | 1 | 32.9 | 13 | 45 | 96 |
| | 2 | 35.0 | 9 | 43 | 94 |
| | 3 | 36.4 | 12 | 46 | 98 |
| 20 | 1 | 35.4 | 16 | 47 | 97 |
| | 2 | 40.0 | 14 | 46 | 97 |
| | 3 | 33.9 | 16 | 46 | 97 |
| 30 | 1 | 39.9 | 14 | 46 | 97 |
| | 2 | 39.5 | 12 | 47 | 98 |
| | 3 | 37.2 | 10 | 47 | 96 |

Table 2. Effect of pH on the yield, gel strength, gelling and melting temperatures of agar extracted from *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica*

| Species | pH | Yield (%) | Gel strength (gm/cm ²) | Gelling temp. (°C) | Melting temp. (°C) |
|---|----|-----------|------------------------------------|--------------------|--------------------|
| <i>G. arcuata</i> var <i>arcuata</i> | 5 | 48.4 | 11 | 42 | 95 |
| | 6 | 48.2 | 15 | 46 | 74 |
| | 7 | 44.2 | 19 | 45 | 98 |
| | 8 | 42.0 | 29 | 45 | 83 |
| | 9 | 44.0 | 21 | 44 | 98 |
| | 10 | 40.2 | 24 | 46 | 93 |
| <i>G. corticata</i> var. <i>cylindrica</i> | 5 | 39.0 | 10 | 45 | 99 |
| | 6 | 40.8 | 10 | 45 | 99 |
| | 7 | 43.3 | 15 | 45 | 98 |
| | 8 | 42.1 | 15 | 45 | 98 |
| | 9 | 39.4 | 13 | 45 | 94 |
| | 10 | 38.4 | 13 | 42 | 89 |

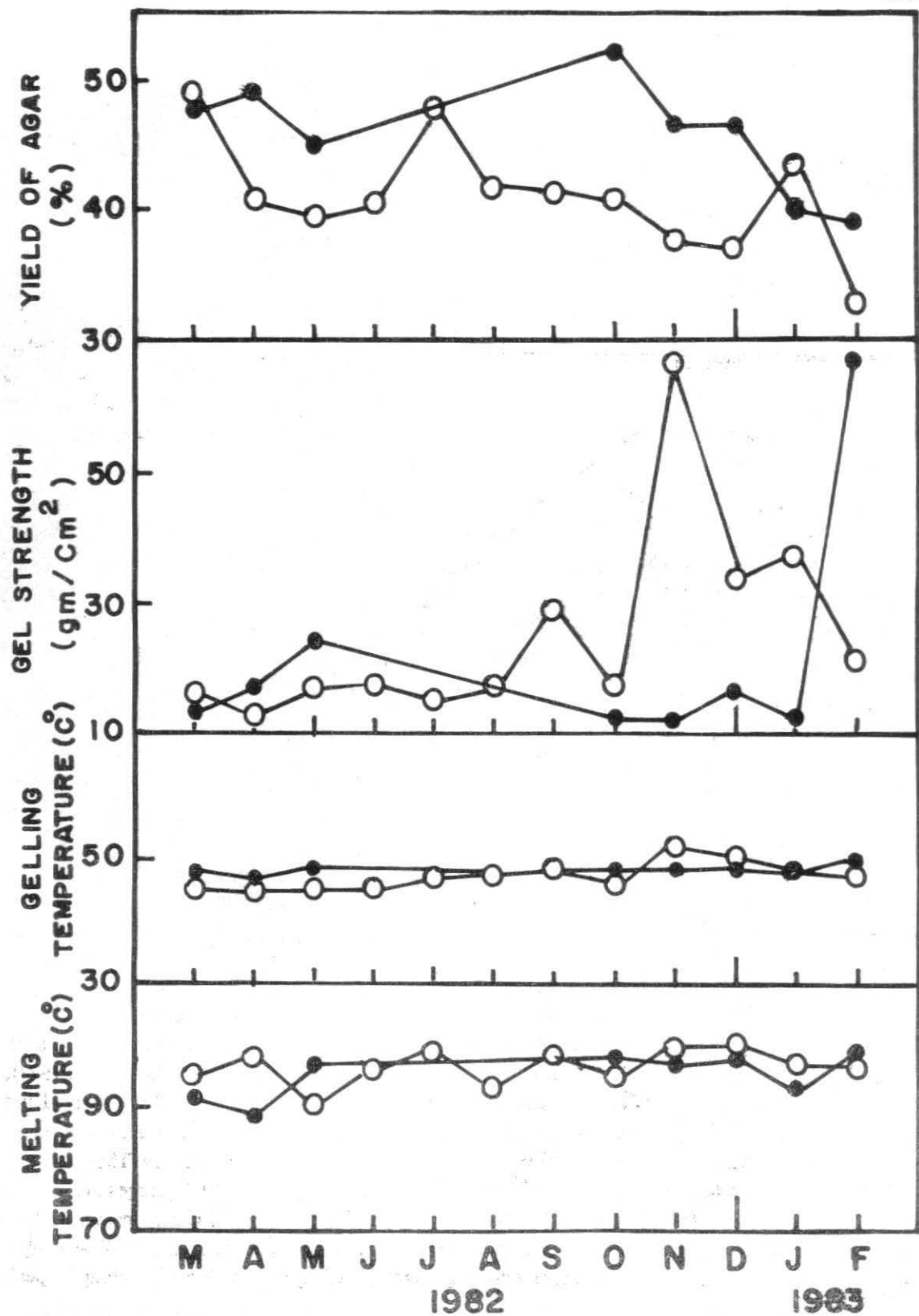


Fig. 1. Monthly variations in the yield, gel strength, gelling and melting temperature of agar extracted from *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica*

at 10, 20 and 30 lbs pressure. For studying the seasonal variation and effect of P^H on the yield and physical properties, the samples were cooked for 2 hrs at 20 lbs pressure. The effect of P^H on the yield and quality of agar was studied by adjusting the p^H of the water used for extraction by adding Hydrochloric acid or Sodium hydroxide.

Results

The monthly values from March 1982 to February 1983 showing the variation in the yield and physical properties of agar in *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica* are plotted in Fig. 1. In *G. arcuata* var. *arcuata*, the yield of agar varied from 38.8% (February) to 52.2% (October). The gel strength of 1.5% agar solution varied from 11 (February) to 67 gm/cm² (October-November). The gelling temperature ranged from 47 to 50°C and melting temperature from 89 to 99°C. In *G. corticata* var. *cylindrica* the agar content varied from 33.1 to 48.6% with maximum yield in March. The gel strength of 1.5% agar solution ranged from 12 (April) to 67 gm/cm² (November). The gelling temperature varied from 45 to 52°C and melting temperature from 90 to 99°C.

Data collected on the effect of different pressure and time of extraction on the yield and properties of agar from *G. corticata* var. *cylindrica* are given in Table 1. Agar yield was found to be more when cooked for 2 hrs at 20 lbs and 1,2 and 3 lbs than that cooked for 1, 2 and 3 hrs at 10 lbs pressure. There was no much variation in gel strength, gelling and melting temperatures of agar extracted in different pressure and time of extraction.

Table 2 shows the results obtained on the effect of different p^H on the yield and quality of agar from *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica*. In *G. arcuata* var. *arcuata* more yield of agar with low gel strength was obtained at 5 and 6 p^H and low yield with more gel strength was obtained at 7-10 p^H . The gelling and melting temperatures of agar extracted in p^H ranging from 5 to 10 did not vary much. In *G. corticata* var. *cylindrica*, there was no much variation in the yield and physical properties of agar.

Discussion

In the present study the yield of agar is found to be more in *G. arcuata* var. *arcuata* than in *G. corticata* var. *cylindrica*. The agar content in these two species is higher than that observed in *Gracilaria crassa* (Umamaheswara Rao, 1970) and *G. foliifera* (Umamaheswara Rao, 1970 and Subba Rao *et al.*, 1977). It can be compared with *Gracilaria corticata* (Umamaheswara Rao, 1970 and 1978 and Subba Rao *et al.*, 1977), *G. edulis* (Umamaheswara Rao, 1970 and Chennubhotla *et al.*, 1977), *G. fergusonii* (Subba Rao *et al.*, 1977) and *G. verrucosa* (Thomas, 1977) and members of Gelidiales such as *Gelidiella acerosa* (Umamaheswara Rao, 1970; Thomas *et al.*, 1975 and Chennubhotla *et al.*, 1977), *G. indica* (Subba Rao *et al.*, 1977) *Gelidium pusillum* and *Pterocladia heteroplotos* (Kaliaperumal and Umamaheswara Rao, 1981). Regular seasonal variation in yield and gel strength of agar reported in *Gracilaria corticata* (Oza, 1978), *G. verrucosa* (Thomas, 1977) and *Gelidiella acerosa* (Thomas *et al.*, 1975). But in *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica* the seasonal changes in the yield of agar was irregular as in *Pterocladia heteroplotos* (Kaliaperumal and Umamaheswara Rao, 1981). There was no correlation between the growth cycle (Kaliaperumal *et al.*, 1986) and agar content in these two algae. However, maximum gel strength of agar was observed during the peak growth period of these two algae.

Maximum yield of agar was obtained in four hour extraction when cultivated plants of *Gracilaria edulis* was extracted for periods ranging from one to six hours (Thomas and Krishnamurthy, 1976). But in the present study there was no much difference in the yield of agar extracted for 1-3 hrs at 10, 20 and 30 lbs pressure. There was no marked variation in the yield, gel strength, gelling and melting temperatures of agar in the acidic and alkaline pH ranging from 5 to 10 in *G. arcuata* var. *arcuata* and *G. corticata* Var. *cylindrica* similar to the results obtained on *Gelidium pusillum* and *Pterocladia heteroplotos* (Kaliaperumal and Umamaheswara Rao, 1981). From the present investigation it may be mentioned that the Indian seaweed industries could use *G. arcuata* var. *arcuata* and *G. corticata* var. *cylindrica* along with *Gelidiella acerosa*, *Gracilaria edulis* and *G. crassa* for the production of agar.

Literature cited

- Chennubhotla, V.S.K., M. Najmuddin & Bidyadhar Naik 1977 Comparative study of the yield and physical properties of agar-agar from different blends of seaweeds. *seaweed Res. Util* 2 : 87-90
- Funaki, K. & Y. Kojima 1951 Studies on the properties of agar-agar from *Gracilaria confervoides* Part 3 *Jap. Soc. Sci. Fish.*, 16: 401-404
- Kaliapermumal, N. M. Umamaheswara Rao. 1981. Studies on the standing crop and phycocolloid of *Gelidium pusillum* and *Pterocladia heteroplotos* *Indian J. Bot.*, 4: 91-95.
- Kaliaperumal, N., Chennubhotla, V.S.K., S. Kalimuthu & J.R. Ramalingam 1986 Growth, phenology and spore shedding in *Gracilaria arcuata* var. *arcuata* (Sanardini) Umamaheswara Rao and *G. corticata* var. *cylindrica* (J. Agardh) Umamaheswara Rao (Rhodophyta). *Indian J. m. Sci.*, 15: 107-110.
- Oza, R.M. 1978 Studies on Indian *Gracilaria* IV. Seasonal variation in agar and gel strength of *Gracilaria corticata* J. Ag. occurring on the coas of Veraval *Bot. mar.*, 21 165-167
- Subba Rao, P.V., K. Rama Rao & K. Subramaiah 1977 Screening of certain red seaweeds for phycocolloids. *Seaweed Res. Util* 2: 82-86
- Thomas, P.C. 1977 Seasonal variation in the yield and physical properties of agar-agar from *Gracilaria verrucosa* (Hudson) Papenfuss. *Seaweed Res. Util* 2: 78-81
- Thomas, P.C. & V.Krishnamurthy 1976 Agar from cultured *Gracilaria edulis* (Gmel.) *Silva Bot mar.*, 19: 115-117
- Thomas, P.C., K. Rama Rao & K. Subbaramaiah 1975 Periodicity in growth and production of agar of *Gelidiella acerosa* (Forrsk.) Fiedmann et Hamel *Indian J. mar. Sci.*, 4:210-212
- Umamaheswara Rao, M. 1970 The economic seaweeds of India *Bull. Cent. mar. Fish. Res. Inst.*, 20: 1-68
- Umamaheswara Rao, M. 1978 Seaweed resources of Andhra Pradesh *Seaweed Res. Util* 3:51-55